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There exists between them the most perfect harmony. They always fall asleep at the same moment, and it is impossible to wake the one without also waking the other.

The author adverts, in the course of the paper, to the question whether they were the produce of a single or a double ovum; and also into that of the possibility, at some future time, of effecting their separation with safety to themselves; and he concludes by bearing testimony to the uniform kind treatment they have received from Capt. Coffin, Mr. Hunter, and Mr. Hale, who have evinced on all occasions the greatest anxiety for their welfare and happiness; and to the liberal manner in which they have always afforded access to men of science for promoting any object of philosophical inquiry.

On some Properties in Achromatic Object-glasses applicable to the Improvement of the Microscope. By Joseph Jackson Lister, Esq. Communicated by Dr. Roget, Secretary. Read January 21, 1830. [*Phil. Trans.* 1830, p. 187.]

The principles on which the reflecting, and also the achromatic refracting telescope are constructed, have been recently applied with considerable success to the microscope, and have added much to the power of that instrument. The author speaks with much commendation of the peculiar construction adopted in Mr. Tulley's compound achromatic microscopes, consisting of a combination of object-glasses of short focus and large aperture, the curvatures of which are such as very nearly to equalize the refractions produced by each. As the magnitude of the aperture, he observes, is valuable only in proportion to that of the pencil of light which it admits, the latter circumstance is that which chiefly claims attention; and as it is often erroneously estimated, a method is pointed out of ascertaining it with sufficient exactness for every practical purpose. He then enters into a detailed description of the several parts of an instrument in his possession constructed on the principles he recommends, referring to the drawings which accompany the paper. The magnifying power may be varied at pleasure, either by drawing out the tubes containing the eye-pieces, or by substituting an eye-glass of different power, or differently combined; and by these changes an uninterrupted range of amplification is obtained from 35 to 800 diameters. No sensible difference as to distinctness is observable, whether the effect is produced by changing the eye-piece, or varying the length of the tubes. The construction of the instrument admits of the utmost variation of magnifying power without the risk of losing sight of the object viewed: and every part which relates to the illumination being wholly detached from the stage, ample opportunity is afforded of rapidly moving the objects, and bringing into view a succession of them, while the light remains the same. Minute directions are given for the employment of the instrument, and its application to various purposes; and great stress is laid on the importance of a skilful management of the light.

In stating the results of his experience on this subject, the author takes occasion to advert to some of the sources of fallacy by which incautious observers with the microscope have so often been greatly misled. When a pencil of rays proceeding from an indefinitely small bright portion of an object is brought to a focus by the most perfect object-glass, the image thus formed is in reality not a point, but a small circle, and will always appear as such if the eye-glass of the microscope be sufficiently powerful. These circles have a considerable analogy to the spurious discs of stars viewed through telescopes. Like the latter, they become much enlarged by diminishing the aperture of the object-glass; and they are also enlarged by increasing the intensity of the illumination. The overlapping of contiguous circles of diffusion has given rise to many fallacious appearances; such as the spottiness which some surfaces assume, and which has been mistaken for globules. This optical illusion has been the basis of some ingenious but visionary speculations on the intimate structure of organic matter. The appearance, in certain directions of the light, of lines on the surface of an object, where they do not really exist, may be traced to a similar cause.

The author proceeds to describe the method he uses for measuring the dimensions of the objects viewed, and notices different test objects with reference to their affording the means of judging of the powers of the instrument. He next enters into a review of the comparative merits of various microscopes constructed by Cuthbert and Dollond in this country, and by Chevalier, Selligue, Amici, Utzschneider, and Fraunhofer, on the continent.

The concluding part of the paper is occupied by the developement of a principle, from the application of which to the construction of the microscope, the author expects that a still greater extension of its powers will ere long be obtained. He remarks, that the circumstance which limits the magnitude of the pencil of light, admissible with high powers by a single achromatic object-glass, is, that the correction for spherical aberration by the concave lens is proportionally greater for the rays that are remote from the centre, than for the central rays. The degree of confusion in the image, thence arising, is, in similar glasses, inversely as the square of their focal lengths. It increases very rapidly with a small enlargement of the aperture, but may be rendered much less considerable by distributing the refractions equally among a greater number of lenses of smaller curvature. Hence the advantage obtained by certain combinations. The experiments made by the author have established the fact, that in general an achromatic object-glass, of which the inner surfaces are in contact, will have on one side of it two aplanatic foci in its axis, for the rays proceeding from which it will be truly corrected with a moderate aperture; that for those proceeding from any part of the interval between these two points, the spherical aberration will be over-corrected; and that for rays beyond these limits it will be under-corrected. Methods are pointed out for ascertaining the situation of these aplanatic foci. The principle here explained furnishes

the means of destroying both kinds of aberration in a large focal pencil, and of thus surmounting what has hitherto been a chief obstacle to the perfection of the microscope.

On the Pendulum. By J. W. Lubbock, Esq. F.R.S. Read March 11, 1830. [*Phil. Trans.* 1830, p. 201.]

The ingenious and beautiful application, made by Capt. Kater, of Huygens's theorem respecting the convertibility of the centres of suspension and oscillation, to the determination of the length of the simple pendulum, is to be considered as a first approximation to the solution of this problem. The accuracy of this determination, however, may be affected by many circumstances which the theory does not take into account; and the object of the author in this paper is to investigate the limits of the errors that may arise from neglecting them. Laplace and Whewell have shown that when the knife-edges are considered as cylinders of small but of equal radii of curvature, their distance is still equal to the length of the simple pendulum. The author treats the question with the utmost generality, and discusses all the circumstances which may affect the accuracy of Capt. Kater's method, including all possible deviations and positions of the axes. He takes, as an example, the pendulum used by Mr. Baily, and described by him in the *Philosophical Magazine* of last February; and investigates the errors which would arise in the length of the simple pendulum corresponding to given deviations of the knife-edges. He also considers the case in which the agate planes are fixed on the pendulum, and vibrate on a fixed knife-edge; and finds that the length of the simple pendulum is here also equal to the distance between the planes.

On the Theoretical Investigation of the Velocity of Sound, as corrected from M. Dulong's recent Experiments, compared with the Results of the Observations of Dr. Moll and Dr. Van Beek. By Dr. Simons, Assistant at the Observatory of the University of Utrecht. Communicated by Captain Henry Kater, Vice-President. Read March 18, 1830. [*Phil. Trans.* 1830, p. 209.]

Laplace has demonstrated that Sir Isaac Newton's formula for obtaining the velocity of sound, requires, in order to render it correct, that it be multiplied by a certain co-efficient, depending on the ratio between the specific heats of atmospheric air under a constant pressure, and under a constant volume. Laplace has endeavoured to deduce this coefficient, first from the experiments of MM. De la Roche and Berard; secondly, from those of MM. Clement and Desormes; and lastly, from the more accurate investigations of MM. Gay-Lussac and Welter. By applying this correction, the velocity of sound, deduced from calculation, corresponded very nearly with the results of actual experiment. Still, however, a degree of discordance was always found to take place. With a view to perfect